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A NEW RACE OF BASILARCHIA ARCHIPPUS CRAMER FROM LOUISIANA (RHOPALOCERA—NYMPHALIDAE).

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The latest revision of the North American *Basilarchia* (Gunder, 1934, Can. Ent. LXVI: 39) recognizes three races of *archippus* Cramer (1779, Pap. Ex. 1, t. 16 a, b) i.e. *a. archippus* inhabiting southern Canada and the Atlantic states as far south as North Carolina and west to Illinois, *a. floridensis* Strecker (1878, Cat. p. 143) found from South Carolina to the tip of Florida and *a. obsoleta* Edwards (1882, Papilio 2: 22) occuring in Arizona, Utah and New Mexico. About fifteen other names have been proposed that now stand in the lists as synonyms, forms, hybrids and aberrations. In Alabama, Louisiana and probably other Gulf states a hitherto undescribed race occurs. This resembles *floridensis* in that the upperside of the primaries is nearly the same mahogany brown color, slightly lighter, but the four sub-apical spots (five in the ♀) are lighter and quite prominent. It differs, also, in the color of the secondaries which are considerably lighter, approximately the color of *archippus,* both wings being usually the same color in the latter race. The undersides of both wings present the same differences. For this race the following name is proposed in honor of Mr. Frank E. Watson.

Basilarchia archippus watsoni n. ssp.

(Plate figs. 1, 2, 3 and 4)

The types and their disposition are as follows:

Holotype—♂, Alexandria, La. Oct. 5, 1935 (John Woodgate) and *Allotype*—♀, Same locality and collector, Sept. 30, 1935, both in the American Museum of Natural History.

Paratypes—5 ♂♂, 1 ♀, Alexandria, La. May 21, 26, Oct. 3, 5, July 3, 1935, Oct. and Oct. 15, 1935, 1 ♂ Pollock, La. Oct. 25, 1936 (John Woodgate); 4 ♂♂ New Orleans, La. May 6, 26, 1921, Mobile, Ala. Aug. 13, 1921, Mt. Vernon, Ala. Oct. 10, 1920; 3 ♀♀ Chalmette, New Orleans, La. Nov. 7, 1919 (W. C. Mattias) and 1 ♀ Perdue Hill, Monroe County, Ala. Aug. 28, 1921 (T. S. Van Alter).

One pair each to the British Museum (Natural History), Canadian National Collection, Academy of Natural Sciences, Carnegie Museum and U. S. National Museum. 1 ♂ to Los Angeles Museum. The remainder are in the author's collection.

BIOLOGICAL CONTROL OF INSECTS THROUGH PLANT RESISTANCE.

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Both insects and man show marked preferences for certain strains or varieties of plants when these plants are used as food. This fact has been known for thousands of years as it applies to man, and has been just as true with respect to insects, though not fully appreciated. Go to any market where plant products are sold and you will find certain preferences shown for special varieties; in fact, it will be difficult or impossible to sell other varieties of the same plant which, from the standpont of nutritive value, might be equal to the ones in demand. Hundreds of millions of dollars have been spent to produce plants to please the taste of man. Only in recent years have we purposely taken into account the food preferences of insects and tried to raise crops with those preferences in mind, that is, non-preferred crops.

The start of this work consisted mainly of field observations and the testing of varieties and strains that had been developed through natural selection in areas where certain species of insects are usually abundant. The plants so selected had in nearly all cases been developed and accepted because of their high yields. Such procedure had unconsciously resulted in the selection of strains which were resistant in one way or another to attacks of insects prevalent in the area where the investigations were made. During the past few years definite progress has been made in purposely developing insect resistant strains of plants by working for that objective. The entomologist and the plant breeder, working together, have attempted, in several cases successfully, to combine the character of insect resistance with the other desirable traits in the same plant. The ultimate purpose of these efforts is to obtain strains, varieties, or hybrids of the various crops which will produce not only high yields of high quality crops, but have combined with these essential attributes the factor or factors responsible for the maximum degree of resistance to insects to which they are exposed. This may really be tolerance or it may besome other type of resistance, but it is the thing we are working for. Just because there are fewer chinch bugs on a stalk of corn, or fewer corn borers in the stalk, is no real reason for growing that variety. It must also be an economically acceptable product. It is this objective that we are now trying to keep constantly in mind and which must be kept as the real one toward which we are working in any program of developing insect-resistant plants.

Methods used up to the recent past have consisted largely of field observations of the reaction of various strains under attack, followed by field tests to ascertain definitely that selected strains were really superior. Out of these tests has come a quite incomplete list of standard varieties which have demonstrated reasonable degrees of insect resistance. These may be strains that carry high or low insect populations. There is always some question when we have a strain of plant which, when grown in a field with fifty other strains, will carry a low

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insect population, as to whether or not this plant would continue to have a low population if it were the only strain grown in the field. This really is not as important as it may seem. Under our conditions it is not likely that one strain would be grown exclusively in any region There will always be too much difference of opinion as to which is the best strain for that locality.

Considerable progress has been made during the last few years in the development of insect-resistant strains of plants, accepting the definition of insect resistance as we have attempted to give it. Most of this work has been done in the line of field crop plants. Mr. Blanchard, of the Federal Bureau of Entomology and Plant Quarantine, and his co-workers have developed a strain of alfalfa which is very highly resistant to the pea aphid. The Kansas and Oklahoma workers in co-operation with the Bureau of Plant Industry have developed several strains of sorghum which are markedly resistant to chinch bugs. Strains of corn resistant to chinch bugs have been developed in Illinois and are quite generally grown in areas where the chinch bug is usually abundant. Real progress has been made in developing corn that is resistant to the corn root worms. Here the character that makes for resistance, or in other words makes for producing a good yield under heavy rootworm infestation, is mainly the power of certain strains to replace roots which have been cut off or killed by the rootworm larvae. Hessian Fly resistant wheat varieties developed by Mr. W. B. Cartwright have been widely adopted on the west coast. F. W. Poos and his co-workers in the Bureau of Entomology and Plant Quarantine have been making very marked progress in the development of plant resistance to insects along various lines. Many more examples could be cited.

The present trend of endeavor is an attempt to isolate from the present known strains, or discover in other strains, the genetic factors responsible for insect resistance and to accumulate these in pure lines so that they may be used in future plant breeding work. Definite progress has been made with corn and wheat and is in view with clover and and other crops.

Any real progress that is achieved must depend on a practical demonstration under actual field conditions. There is obviously a very wide field for further progress, especially in the line of the deciduous fruits and in truck and canning crops. Some excellent work is being done in Wisconsin in developing strains of peas which are resistant to the pea aphis, and other work on the canning crops is in progress in other parts of North America. Certainly there is an excellent opportunity in this field for further work.

In citing some of the definite results that have been obtained in the work to date, we could probably do no better than to draw these examples from the summary presented at the recent conference of the North Central States Entomologists' meeting at Columbus, Ohio. From these we can consider first the matter of work done on corn for insect resistance to the chinch bug. Under Illinois conditions the following inbreds have been found resistant in that they contribute to the production of corn hybrids with higher yields of good quality which is resistant to typical chinch bug lodging:

Ill. Hy—Kys—K4?—Ill. R. 4—Ill. 90—

Numerous other varieties have been tested by R. O. Snelling and R. A. Blanchard in Illinois and Dr. R. H. Painter in Kansas. Other corn varieties have been tested by the same men for grasshopper resistance and resistance to the corn ear worm.

In Kansas Ys75 has been found highly susceptible by R. H. Painter. W. A. Baker, L. H. Patch and M. Scholsberg have run numerous tests in an attempt to find corn resistant to the European corn borer. Some of the resistant inbreds tested were: R4, L317B2, Mich. 77, I 205, Mich. 1828, Minn. 2634.

Dr. L. L. Huber and G. H. Stringfield of the Ohio Agricultural Experiment Station have found certain varieties of corn 20% above open-pollinated strains in their resistance to the European corn borer.

J. P. Sleesman of the Ohio Station has found certain onion varieties highly resistant to the onion thrip and certain varieties of potato resistant to potato leafhopper.

R. H. Painter of Kansas, C. M. Packard, Washington, D. C., and W. B. Noble of Indiana have gathered much data to show that certain varieties of wheat are resistant to Hessian fly.

R. H. Painter and L. L. Huber have shown that some wheats are more resistant to chinch bugs than others.

R. O. Snelling in Oklahoma and R. H. Painter in Kansas have found certain strains of sorghums very highly resistant to chinch bugs.

J. H. Bigger in Illinois has shown difference in resistance to attack of the corn root worm, not through any characteristic of the plant that reduces feeding but because of the fact that certain strains appear to more quickly recover from the severe root proliferation caused by the attack of this insect and to form a good series of new roots replacing the injured roots.

Aside from field crops, orchardists have for many years noted resistance by certain species of apples to the San Jose scale. General varieties such as Ben Davis, Grimes, Golden Delicious, Rhode Island Greening, and a number of others are very highly susceptible, while Jonathan, Staymen, and Winesap are quite noticeably resistant. Red Delicious and Ben Davis are much more readily injured by codling moth than Winesap.

A NEW RACE OF INCISALIA NIPHON HBN. WITH NOTES ON STRYMON ACADICA EDW. (LEPID. LYCAENIDAE)*

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Dr. Austin H. Clark recently drew the attention of Dr. McDunnough to the fact that specimens of *Incisalia niphon* from Canada differ in several respects from *niphon* as it occurs in Florida (type locality) and other southern localities. Dr. Clark has kindly furnished a female specimen of *niphon*, taken at Mt. Vernon, Va., which upon study I have found to agree quite well with typical *niphon* as figured by Hubner in the Zutrage Exot. Schmett. figs. 203 and 204.

Specimens of *niphon* from Ontario differ from the typical form in the

*Contribution from the Division of Entomology (Systematic Entomology) Department of Agriculture, Ottawa.

distinctly paler color of the upper surface, the golden brown ground color of the under surface, and the almost entire absence of the black band at the outer third of the underside of the primaries. I propose, therefore, to designate this northern race as:

Incisalia niphon var. **clarki** n. var.

Upper surface: ♂, dark glossy brown with metallic ferruginous scales more numerous toward the base of the primaries and the anal angle of the secondaries; ♀, mostly ferruginous, shading to dark brown toward the basal halves and narrowly dark along the costal and outer margins of both wings.

Under surface of both sexes with markings much less contrasting than in the southern specimen owing to the golden brown ground color and the reduction of the black scaling. The transverse streak at the outer third of the primaries is composed of a narrow black line, about the same width as the white which surmounts it outwardly, and bordered inwardly by a band of golden brown as wide or wider than the sum of the black and white. (In the Mt. Vernon specimen this golden brown band is replaced by black causing the black to appear three times as wide as the white which borders it outwardly). The two transverse bars crossing the cell at the basal third of the primaries are mostly brown or bordered with black and rather indistinct on the northern specimens while again in the southern specimen and in Hubner's figure they are broadly black and very pronounced. The broad irregular band which crosses the secondaries before the middle is golden brown toward the edges and bordered faintly with black surmounted by white. (In the Mt. Vernon specimen this band is dark brown toward the edges and strongly bordered with black surmounted by white). Ground color less violet than that of the Mt. Vernon specimen or of Hubner's figure, with more of a tendency toward light brown. Expanse 24-29 mm.

Holotype—♂, Constance Bay, Ottawa region, Ont., June 4, 1938 (E. G. Lester); No. 4430 in the Canadian National Collection, Ottawa.

Allotype—♀, same locality, June 18, 1933 (G. S. Walley).

Paratypes—18 ♂♂, 31 ♀♀, same locality, June 16 to July 2, 1933; June 15, 1934, June 4, 1938.

In addition to the type series there are specimens agreeing with the above description in the Canadian National Collection from the following localities: Wright, Kazubazua, Meach Lake, Aylmer, Norway Bay, Quyon and Chelsea, Que.; Mer Bleue, Merivale, Port Hope, Minden and Bobcaygeon, Ont. All of these localities are within the Ottawa district except the last three.

Strymon acadica Edw.

Strymon acadica was originally described by Edwards from a specimen taken at London, Ont. Subsequently C. P. Whitney described *S. souhegan* from Milford, New Hampshire, this name being considered by most authors as synonymous with *acadica*. Watson and Comstock (Bull. Amer. Mus. Nat. Hist., XLII, 449, 1920) regarded *souhegan* as a valid race of *acadica*, basing their opinion on a series of specimens from Gravenhurst, Ontario, which they considered typical *acadica*. These, they noted, were darker on the underside than *souhegan* as represented before them by a series of specimens from Hewitt, New Jersey.

They also described the aberration *Strymon acadica acadica* ab. *muskoka* from a specimen in the Gravenhurst series.

After studying specimens from southwestern Ontario including a topotypical male from London, Ont., and a series from the near-by Leamington and Point Pelee regions, as well as a series from New Jersey, all of which have rather pale undersides, the writer is convinced that all of these represent typical *acadica* and that *souhegan* is not distinguishable from it. On the other hand specimens from more northern localities, Port Hope, Bobcaygeon and Ottawa, Ont., and Aylmer, Norway Bay and Meach Lake (Chelsea) Que., have noticeably darker undersides, and in this respect appear to agree with specimens from Gravenhurst, according to Watson and Comstock's remarks concerning their series from that locality. It may be noted that all of these latter localities lie within the Canadian or Transitional faunal zones, whereas the localities for *acadica* are Carolinian in character.

For the race with darker underside, represented by specimens from the above mentioned localities, the name *muskoka* would appear available, notwithstanding the fact that this name as originally proposed applied to an aberration. To the writer's mind the more rational procedure would be to propose a new racial name, leaving the name *muskoka* for the aberration, but such a practice cannot be followed without incurring synonymy if this name is recognized as being valid in nomenclature. In this instance, it is the writer's opinion that doubt exists as to whether the name *muskoka* as originally applied, (i.e. as a quadrinomial) has any validity, there being no provision in the International Rules for the naming of categories above trinomials (Article 2).

SYNTHETIC ORGANIC COMPOUNDS USED AS INSECTICIDES

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For many years chemists and entomologists have been seeking the hypothetical ideal insecticide, namely, a material which is toxic to insects at an economical dosage, which is not injurious to the host plant or animal sprayed or dusted with it, and which does not leave on foodstuffs a residue that is poisonous to man or domestic animals. Certain organic compounds approach closer to this ideal than any products of mineral origin, and the successful use of these against some of our most injurious insects has greatly stimulated the testing of countless organic products for insecticidal value.

Tests of synthetic organic compounds as insecticidal fumigants were made more than 25 years ago. The use of many organic compounds as war gases during the World War suggested their application for the destruction of insect pests, and one of these war gases, namely chloropicrin, is today in commercial use as a fumigant. About 1922 the United States Department of Agriculture became interesting in finding a substitute for carbon disulphide for killing weevils in grain. Investigations on this subject were reported in 1925 by Neifert et al. (10). Of more than 100 organic compounds tested on rice weevils, 30 were found to be more toxic than carbon disulphide. Included among these were chlorides, bromides,

iodides, thiocyanates, isothiocyanates, formates, acetates, and certain other compounds.

Roark and Cotton (17) in 1930 reported a continuation of this study in which 309 compounds were tested, and as a result of which certain relationships between chemical structure and insecticidal action were discovered. Compounds that are quite inert chemically, such as paraffin hydrocarbons have but little toxicity in the vapor phase. Compounds belonging to the following classes are the most toxic: Iodides, bromides, mercaptans, thiocyanates, isothiocyanates, disulphides, oxides, epichlorohydrins, halogenated ether, halogenated esters, and formates.

Tests with organic compounds as fumigants to be used in place of hydrogen cyanide were reported by Cupples and coworkers (5) in 1936. The following compounds were found to be decidedly toxic to the California red scale; Isobutyl mercaptan, n-butyl thiocyanate, chloropicrin, ethyl acrylate, ethylene oxide, ethyl thiocyanate, ethyl isothiocyanate, hydrogen sulphide, methyl acetate, methyl propionate, methyl thiocyanate, methyl isothiocyanate, oxalyl chloride, n–propyl chlorocarbonate, isopropyl ether, and isopropyl thiocyanate. Methyl thiocyanate and hydrogen cyanide appear about equally effective, mol for mol, in killing the red scale.

Tests of synthetics as stomach poisons for insects date back nearly thirty years. A wide variety of organic compounds has been proposed for mothproofing woolen fabrics and for impregnating paper, wood, and other cellulose products to render them resistant to the attacks of termites and other pests. Several hundred compounds proposed for this purpose are listed in the three indexes of "Patented Mothproofing Materials," by Roark (11, 12) and Roark and Busbey (16). Only a few of these have come into commercial use for mothproofing wool. However, it seems worth while to test many of these mothproofing products as stomach poisons against leaf-eating agricultural pests.

Certain organic compounds have been proposed for use as wetting agents and emulsifying agents for use with insecticides and fungicides. These compounds are mostly sulphated alcohols or sulphonated aromatic compounds. A list of the more widely used products of this nature has been compiled by Cupples (4).

A considerable number of organic compounds exclusive of mothproofing materials have been proposed as insecticides. Roark and Busbey (14) compiled a list of 315 organic sulphur compounds used as insecticides, and Vivian (21) recently added 240 compounds to this list. The number of non-sulphur organic compounds that have been proposed as insecticides is probably much greater.

At present the principal synthetic organic compounds in commercial use for insect control are as follows:

Fumigants: Napthalene, carbon disulphide, paradichlorobenzene, chloropicrin, ethylene oxide, ethylene dichloride, propylene dichloride, carbon tetrachloride, ethyl formate, methyl formate, methyl bromide, hydrocyanic acid, and synthetic camphor.

Contact insecticides; Various aliphatic and aromatic thiocyanates and isothio-

cyanates, dinitro-o-cresol, dinitro-o-cyclohexylphenol, and derivatives of cyclohexylamine.

Stomach insecticides: Phenothiazine.

Repellents: Tetramethyl thiuram disulphide.

It seems worth while to review briefly the uses and future possibilities of some of these materials.

Among the synthetic organic compounds used as fumigants, hydrogen cyanide and carbon disulphide have long been known and an account of their uses seems unnecessary. Chloropicrin, a tear gas, found to have insecticidal value in 1917, has proved valuable for the fumigation of stores, warehouses, and ships, and for combating nematodes and insects in soil. Information on chloropicrin has been compiled by Roark (13) and by Roark and Busbey (15). The formates are suitable for the fumigation of foodstuffs, especially raisins, and of tobacco. Ethylene dichloride and propylene dichloride are useful for killing weevils in grain and fabric pests in furs and clothing. Their slight fire hazard may be eliminated by the addition of 1/3 carbon tetrachloride by volume (1, 7), which by itself has only low insecticidal value. Ethylene oxide has proved valuable for the fumigation of spices, packaged cereals, dried fruits, nuts, books, tobacco and clothing. It is commonly used in admixture with carbon dioxide (2, 3, 22). Methyl bromide is effective in killing many insects in fresh vegetables (such as Japanese beetles in string beans) without injury to the produce. This is a unique property among fumigants and the future of this compound appears bright. The insecticidal action of paradichlorobenzene has been known about 25 years. It is widely used to combat the clothes moth and the peach borer Naphthalene is a valuable greenhouse and soil fumigant, as well as being the material from which mothballs are made. The use of either natural or synthetic camphor as an insecticide is limited to combating clothes moths.

Attention is called to the many uses to which these different fumigants are put. There is some overlapping in use, but these products vary so in toxicity to different species of insects and to different species of plants, as well as in their volatility, odor, fire hazard, health hazard to man, and cost, that each material has its own field of usefulness. This should be kept in mind in working with organic compounds as contact or as stomach poisons for insects. Because of the high specificity of organic compounds, in insecticidal action and the difference in toxicity to plants and to man, we shall need a whole pharmacopoeia of synthetic organic insecticides with which to combat a host of insect pests.

Fewer synthetics are being used as contact insecticides than as fumigants. This is because certain organic compounds of plant origin are preeminent as contact insecticides and it has been difficult to find synthetics to equal them. Reference is made to nicotine, anabasine, the pyrethrins and rotenone and related compounds from Derris, Lonchocarpus, Mundulea, and Tephrosia. Hydrocarbons derived from petroleum oil (which may be of either plant or animal origin) are also very extensively employed as contact poisons for insects. Much work to find a synthetic suitable for use as an aphicide has been carried on. Tattersfield (19) in 1927 reviewed previous work in this field and reported the results of his own tests of aromatic hydrocarbons and their chloro, nitro, and hydroxy de-

rivatives and also of other compounds. Certain relationships between chemical constitution and insecticidal action were pointed out. 3, 5-dinitro-o-cresol was found to have a powerful ovicidal effect and this compound is today in commercial use as an insecticide. Tattersfield (20) again in 1937 reviewed developments in synthetic organic insecticides.

At present the most widely used contact insecticides of synthetic origin are butyl carbitol thiocyanate and lauryl thiocyanate. The former is used in place of pyrethrins in kerosene-type fly sprays. When added to rotenone or a derris extract, a spray is obtained that produces a quick knockdown and also a high kill of houseflies. Lauryl thiocyanate is highly effective against certain plant pests, especially red spider, but some plants are injuriously affected when sprayed with it.

In this connection the writer wishes to call attention to the fact that organic thiocyanates were first found to have insecticidal value by workers in the United States Department of Agriculture (10, 17) (See Neifert et al., and Roark and Cotton).

Isothiocyanates have also been studied for insecticidal value, and only recently the alpha-naphthyl isothiocyanate has been put on the market. In general the isothiocyanates resemble the thiocyanates and have the same limitations.

Derivatives of cyclohexylamine has shown some promise in tests upon aphids and red spider. Of 41 derivatives tested, N, N-amylbenzoyl cyclohexylamine, and N, N-amylacetyl cyclohexylamine ranked the highest in contact insecticidal properties (8).

Of the synthetic organic compounds tested as stomach poisons to insects, phenothiazine displays the most promise. This organic compound was prepared and tested for insecticidal action several years ago by L. E. Smith. Since that time it has been tested against a great many classes of insects of economic importance both in the laboratory and under field conditions. It is highly specific in its action, being either highly toxic to the test insect involved or else relatively nontoxic.

Results of pharmacological tests against warm-blooded animals show definitely that phenothiazine is a safe insecticide from a public-health standpoint. When used alone, phenothiazine causes little if any foliage injury. However, it is not compatible with bordeaux, bentonite, or fish oil and causes foliage injury when applied with or after oil sprays.

Phenothiazine is highly toxic when tested against the following insects: Rusty plum aphid, young screwworm larva, Colorado potato beetle, Mexican bean beetle, and corn ear worm on tomato. It is more toxic than rotenone to mosquito larvae. Phenothiazine looks very promising for the control of the corn earworm and European corn borer. It is more toxic than lead arsenate to the grape berry moth and graperoot worm. In experimental field tests phenothiazine gave good control of the apple maggot. In the Pacific northwest phenothiazine has been found to give excellent control of the codling moth, except in 1937 when an unusual rain in June washed the insecticide off. However, in other apple-growing regions the results indicate that it will be necessary to develop a suitable sticker

to prevent its being washed off by rain before adequate control of this insect will be obtained.

Preliminary results indicate that phenothiazine should be further investigated for the control of the southern armyworm and imported cabbage worm. The compund is nontoxic to the European spruce sawfly. It is definitely inferior to calcium arsenate when tested against the greenhouse leaf tier. Phenothiazine has a narcotic effect on the Japanese beetle and is also somewhat repellent but not toxic to this insect. Phenothiazine was found to be relatively nontoxic to various types of cotton insects and to honeybees. It has some toxicity to the plum curculio and the tomato pinworm. When tested against citrus thrips, red mites, and apple aphids, the compound was found to be ineffective.

One of the most interesting observations regarding the insecticidal value of phenothiazine is that recorded by Knipling (9). When fed to cattle at the rate of about 100 mg. or less per kilogram of body weight, phenothiazine prevented the development of horn fly larvae in the manure eliminated by these animals.

Of strictly synthetic compounds used as repellents, tetramethyl thiuram disulphide is reported as promising as a repellent to adult Japanese beetles.

Some of the synthetic organic compounds recently found to have insecticidal value when tested on mosquito larvae are the following: Phenothiazine, 4–(p–bromophenylazo)–resorcinol, 4–(p–bromophenylazo)–o–cresol, 4-(p–bromophenylazo)–phenol, 4–(2, 5–dichlorophenylazo)–o–cresol, 4-(p-bromophenylazo) m–cresol, phenyl mercaptan, phenoxathiin, p–tolyl mercaptan, and 6-methylphenothiazine (6). These are more toxic than rotenone.

Smith, Siegler, and Munger (18) recently reported that of 200 compounds tested upon codling moth larvae laboratory methods the following were the most effective: 3, 5–dinitro–o–cresol, p–iodonitrobenzene, 2-thiocoumarin, phenoxathiin, 1–phenyl–benzoxazole, 3, 5–dinitro–o–cresol acetate. In these laboratory tests each of the six compounds caused 90 percent or more of the fruit to be free from worms.

The relationship between the chemical constitution of organic compounds and their toxicity to insects is of great interest to chemists and entomologists and much study has been devoted to it. It has been found by Gersdorff that para-substituted phenols (chloro, nitro, and methyl phenols) are more toxic to gold fish than are the corresponding ortho or meta compounds. Tests on insects as well as with goldfish have shown that when oxygen in an organic compound (e.g., an alcohol or a phenol) is replaced by sulphur the resulting compound is more toxic. When tested as fumigants iodo compounds are more toxic than bromo compounds, and these in turn are more effective than chloro compounds. However, but little headway has been made in establishing relationships between structure and toxicity when complex heterocyclic compounds are studied.

In conclusion the writer wishes to emphasize again the specificity in toxicity to various species of insects exhibited by synthetic organic compounds. This means that many synthetics must be developed to take the place of a few arsenicals which are effective against a wide range of species. A few score synthetics are now known that appear very promising for use as insecticides. Some of these are even more potent than rotenone. It is confidently believed that within

a few years synthetic organic insecticides will be available for effective and economical use against many of our injurious insects.

BIBLIOGRAPHY

1. Cotton, R. T., and R. C. Roark 1927. Ethylene Dichloride-Carbon Tetrachloride Mixture; a New Non-Burnable, Non-Explosive Fumigant. Jour. Econ. Ent. 20(4): 636-639. August.
2. Cotton, R. T., and R. C. Roark 1928. Ethylene Oxide as a Fumigant. Indus. & Engin. Chem. 20(8): 805. August.
3. Cotton, R. T., and H. D. Young 1929. The Use of Carbon Dioxide to Increase the Insecticidal Efficacy of Fumigants. Proceedings of the Entomological Society of Washington, 31(5): 97-102. May.
4. Cupples, H. L. 1938. A List of Proprietary Detergents, Wetting Agents, and Emulsifying Agents, E-426, U. S. Dept. Agr., Bur. Ent. & Plant Quar., 24 pp., mimeo. May.
5. Cupples, H. L., H. R. Yust and Julian Hiley 1936. Tests of Possible Substitutes for Hydrocyanic Acid in Fumigation of California Red Scale. Jour. Econ. Ent. 29(3): 611-618. June.
6. Fink, D. E., L. E. Smith, D. L. Vivian, and H. V. Claborn 1938. Toxicity Tests with Synthetic Organic Compounds against Culicine Mosquito Larvae, U. S. Dept. Agr. Bur. Ent. & Plant Quar. E-425, 34 pp. mimeo. March.
7. Gersdorff, W. A. 1932. Bibliography of Ethylene Dichloride. U. S. Dept. Agr. Misc. Publication No. 117, 60 pp. Feb.
8. Kearns, C. W., and W. P. Flint 1937. Contact Insecticidal Properties of Various Derivatives of Cyclohexylamine. Jour. Econ. Ent. 30: 158-166. February.
9. Knipling, E. F. 1938. Internal Treatment of Animals with Phenothiazine to Prevent Development of Horn Fly Larvae in the Manure. Jour. Econ. Econ. 31: 315-316. April.
10. Neifert, Ira E., F. C. Cook, R. C. Roark, W. H. Tonkin, E. A. Back, and R. T. Cotton. 1925. Fumigation against Grain Weevils with Various Volatile Organic Compounds. U. S. Dept. Agr. Dept. Bull, No. 1313, 40 pp. January 26.
11. Roark, R. C. 1931. An Index of Patented Mothproofing Materials. U. S. Dept. Agr., Bur. Chemistry & Soils. 125 pp. mimeo. May.
12. Roark, R. C. 1933. A Second Index of Patented Mothproofing Material. U. S. Dept. Agr., Bur. Ent. & Plant Quar., 109 pp. mimeo. February.
13. Roark, R. C. 1934. A Bibliography of Chloropicrin, 1848-1932. U. S. Dept. Agr. Misc. Publication No. 176, 88 pp. February.
14. Roark, R. C., and R. L. Busbey 1935. A List of Organic Sulphur Compounds (exclusive of Mothproofing Materials) Used as Insecticides, E-344, U. S. Dept. Agr., Bur. Ent. & Plant Quar., 104 pp. mimeo. May.
15. Roark, R. C., and R. I. Busbey 1935. Bibliography of Chlorcopicrin, 1932-1934 (First Supplement to U. S. Dept. Agr. Misc. Publication No. 176). U. S. Dept. Agr. Bur. Ent. & Plant Quar. E-351, 15 pp. mimeo. June.
16. Roark, R. C., and R. L. Busbey 1936. A Third Index of Patented Mothproofing Materials. U. S. Dept. Agr., Bur. Ent. & Plant Quar., 104 pp. mimeo. February.
17. Roark, R. C. and R. T. Cotton 1930. Tests of Various Aliphatic Compounds as Fumigants. U. S. Dept. Agr. Tech. Bull. No. 162, 52 pp. March.
18. Smith, L. E., E. H. Siegler, and F. Munger. 1938. Some Organic Compounds Found Highly Toxic to Codling Moth Larvae in Laboratory Tests. Jour. Econ. Ent. 31(2): 322-323. April.
19. Tattersfield, F. 1927. The Relationship between the Chemical Constitution of Organic Compounds and their Toxicity to Insects. Jour. Agr. Sci. [England] 17. 181-208.
20. Tattersfield, F. 1937. Modern Developments in Research on Insecticides. Part I. General Survey. Jour. Soc. Chem. Indus. 56: 79T-85T.
21. Vivian, D. L. (In press) A Second List of Organic Sulphur Compounds Used as Insecticides, supplement to E-344. U. S. Dept. Agr., Bur. Ent. & Plant Quar. Mimeo.
22. Young, H. D., and R. L. Busbey. 1935. References to the Uses of Ethylene Oxide for Pest Control. U. S. Dept. Agr. Bur. Ent. Plant Quar., Mimeo, 16 pp. April.

PAMMEGISCHIA AND TRICHOFOENUS DISCARDED (AULACOID HYMENOPTERA).

BY HENRY K. TOWNES, JR.
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It is strange that such a distinct genus as *Aulacus* should not have been recognized by American workers, but there seems to be no doubt that our *Pammegischia* Provancher, 1883 is merely *Aulacus* Jurine, 1807.

While determining a small lot of aulacids recently, I chanced to examine a specimen of *Aulacus striatus* Jurine determined by Schletterer. Noting that it seemed to belong to the same genus as the species that in America have been put in *Pammegischia,* I have tried to find ways by which *Aulacus* and *Pammegischia* might be distinguished. Bradley[1] distinguishes the two genera by saying that the tarsal claws of *Aulacus* have a single tooth while those of *Pammegischia* are without teeth. I have made microscope slides of the tarsi of *Aulacus striatus* (the genotype of *Aulacus*) and of *Pammegischia burquei* (the genotype of *Pammegischia*) and find that in both there is a basal tooth, small but very definite, on all the claws. The tooth is so near the base that it is easily overlooked and the claws appear simple. Kieffer[2] evidently had not seen *Pammegischia* and probably simply quoted the characters from Bradley. Besides ascribing simple claws to *Pammegischia* he states that *Aulacus* has three cubital cells. I find that *Aulacus striatus* has only two cubital cells and a venation identical with that of *Pammegischia burquei.*

The only true *Aulacus* known was *striatus* Jurine. Adding the species of *Pammegischia* to *Aulacus,* we have also *ashmeadi* Bradley, *burquei* Provancher, *lovei* Ashmead, *minnesotae* Bradley, *ouelletii* Bradley, and *pallipes* Cresson. *Ouelletii* is probably the male of *burquei*. *Striatus* occurs in Europe, while the rest occur in Canada and the northern half of the United States. *Striatus* is similar to our *ashmeadi,* but has the front of the mesonotum vertical and simple instead of overhanging and somewhat emarginate as in *ashmeadi.* Kieffer[3] lets eleven other species from various parts of the world remain in *Aulacus,* mostly if not entirely, because he can not discern from the descriptions where they should properly be placed. It seems probable that all of these species belong elsewhere.

Aulacus is easily distinguished by the fact that the veins of the hind wing are obsolete except for the subcosta; the claws have only a single tooth at the extreme base, and the female has a prominent tooth on the hind coxa extending beyond its tip below. This tooth is grooved to form a guide for the ovipositor, and although all aulacids have the coxae grooved, no other has developed this tooth. *Aulacus* is also unique in being parasitic mainly on *Xiphydria.*

It should also be pointed out that the name *Gasteruption* has been misused. Since Kieffer's time it has been customary to put the species of the old genus *Gasteruption* into *Trichofoenus* if the eyes are hairy and into *Gasteruption* if the eyes are bare. I have examined specimens of *Gasteruption assectator* Linnaeus and *Gasteruption jaculator* Linnaeus, the genotypes of *Gasteruptiton* Latreille, 1796

1. Trans. Amer. Ent. Soc. 1908 34: 120.
2. Das Tierrech 1912 30: 344.
3. Das Tierreich 1912 30: 371.

and *Foenus* Fabricius, 1798 respectively. The specimens were determined by Dr. A. Roman, who has studied the Linnaean types and has collected around Upsala, the probable type locality. *Gasteruption assectator* has hairy eyes and an ovipositor about a fourth as long as the abdomen while *Gasteruption jaculator* has bare eyes and an ovipositor about as long as the body. Kieffer separates his genus *Trichofoenus* from *Gasteruption* on the presence of hair on the eyes. The type of *Trichofoenus* Kieffer 1910 is *Trichofoenus merceti* Kieffer, a species with hairy eyes and the ovipositor as long as the body. On the character of hairy eyes, *Trichofeonus* would become a synonym of *Gasteruption* and those with bare eyes would be called *Foenus*. Another division of *Gasteruption,* perhaps more natural, would be on the length of the ovipositor—about one fourth as long as the abdomen or about as long as the body. If one used this division, those with the short ovipositor would be called *Gasteruption* and those with the long ovipositor would be called *Foenus* with *Trichofoenus* as a synonym.

NOTES ON THE EARLY STAGES OF SOME HESPERIINAE.

BY V. G. DETHIER,

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The following notes will serve to supply some of the desiderata listed by Scudder for the life histories of New England Hesperiinae. Descriptions are also given when they differ from those of Scudder or when they supplement his information. Detailed descriptions are given of *Poanes hobomok* Harr. because it has been impossible to determine which species Scudder described under the name *Atrytone zabulon*. Insomuch as the ranges of the two species overlap, the two were confused as one at the time of Scudder's description and the source of his material is unknown.

Polites manataaqua Harr.

Egg. Very light grass green to blue green, surface microscopically punctured, divided faintly into numerous polygonal cells. Height, .8 mm.; greatest diameter, .9 mm. Other characters agree with Scudder's description.

First Instar. Head width, .6 mm; head height, .5 mm. Body length 2 to 2.5 mm. Head very light brown. Antennae, mouthparts, edges of mandibles, sutures, and edge of foremen magnum deeper brown. Dark pigment of the ocelli visible through the head capsule. Head slightly corrugated. Shield fuscous. Few short whitish hairs on head and shield. Body cream colored, sparsely clothed with short transparent hairs, those on the last segment recurved, reaching forward to the preceding segment. First pair of legs fuscous. Other body appendages same color as body.

The adult females were taken on *Asclepias* July 31. The eggs were laid on August 1, 2, 4, and 8. The first instar larvae emerged August 17 to 20 having passed from twelve to seventeen days in the egg.

Polites themistocles Latr.

Egg. Agrees with Scudder's description.

First Instar. Head width, .55 mm.; head height, .60 mm. Body length, 2.2 mm. Head dark fuscous almost black, shiny but with short irregular corrugations. Few whitish hairs. Head appendages same color as head. Shield also of

same color. Body white, smooth but distinctly transversely wrinkled in the intersegmental areas. For further description Scudder is perfect.

Second Instar. Head width, .75 mm.; head height, .8 mm. Body length, 5.5 to 7.5 mm. Head piceous, minutely shagreened with few scattered whitish hairs. Body pale green to brown. Last segment murky blue green. Dorsal thoracic shield same color as head but shiny. Body sprinkled with many minute fuscous tubercles giving rise to exceedingly short setae of the same color. Setae slightly longer on anal segment. Setae arranged in a definite pattern. Dorsally on each segment there are six transverse rows, two on the anterior portion of the segment, one located in the middle, and three on the posterior portion. The anterior and posterior rows meet and become continuous laterally just above the stigmatal line. The stigmatal line is naked. There is a substigmatal longitudinal row of setae followed ventrally by a naked area which is in turn succeeded ventrally by another irregular line. At the bases of the legs there is a scattering of setae. The ventral surface of the body is light yellow. Legs and prolegs, pale yellowish.

Third Instar. Head width, 1.2 mm.; head height, 1.3 mm. Body length, 8 mm. Head roughly shagreened almost black. Body light chocolate brown tinged with greenish. Dorsal vessel dark green finely mottled with murky greenish spots. Setae as in second instar.

Fourth Instar. Head width, 1.8 mm.; head height, 1.9 mm. Body length, 11 mm. Head minutely and regularly shagreened. Many whitish hairs scattered over entire surface. Body very deep chocolate mottled with irregular almost whitish patches. Mid-dorsal line solid dark greenish due to lack of mottling. Pleural region dark greenish brown. Faint narrow even chocolate substigmatal line. Setae same as in second instar only darker and more numerous. Long light brown hairs on anal plate. Spiracles brown with blackish circumference.

Eggs laid on June 14 hatched on June 25. The first instar was of seven days duration, moults occurring on July 2. The second instar required eleven days for its completion, moulting occurring on July 13. After ten days the animals moulted into the fourth instar, July 23.

Polites mystic Scud.

Egg. Pale blue green. Height, .75 mm. Greatest diameter, .9 mm. The remaining details agree with Scudder.

First Instar. Head width, .45 mm.; head height, .5 mm. Body length, 1.5 to 4 mm. Head light brown to almost black, minutely and faintly corrugated. Few short scattered transparent hairs. Shield same color. Body cream to exceedingly light green. First pair of legs fuscous. Spiracles same color as body, circumference brown. Body transversely wrinkled especially at intersegmental membranes. Several rows of exceedingly short transparent hairs. Two dorsal pairs of rather long forward recurved hairs on anal plate, also two shorter pairs decurved backward.

Second Instar. Head width, .75 mm.; head height, .6 mm. Body length, 4 mm. Head darker than previous instar. Body clear green merging to dirty cream posteriorly and ventrally. Legs fuscous, prolegs same color as ventral surface of body. Head with hairs more numerous and more strikingly white. Body covered

with small black setae arising from numerous black tubercles. Many long hairs on anal plate. Except for a scattering on the first five segments there are no setae ventrally. Dorsally they are arranged in more or less transverse rows extending to the stigmatal line. Below this is naked except for one longitudinal band and two short rows above each leg.

Third Instar. Head width, 1 mm.; head height, .8 mm. Body length, 5 mm. Head darker more roughly shagreened than above. Body yellow green to brown with more numerous setae. Two lateral bands of setae very pronounced.

Eggs were laid on June 14, 19, 20, and 21. Larvae emerged in from eight to twenty-two days. Of thirty-five eggs laid on June 19, twelve hatched on June 25 and 26, six to seven days having elapsed; twelve emerged on July 6, seventeen days having elapsed; ten emerged July 9, twenty days having elapsed; and one hatched on June 11, twenty-two days having elapsed since oviposition. While some eggs were just hatching, others of the same batch laid at the same time were larvae in the second instar. The first instar consumed from ten to twenty-two days; the second instar, approximately ten days; the third instar, an equal amount of time.

Catia otho A. & S., race egeremet Scud.

Egg. Height, .60 mm.; greatest diameter, .75 mm. Polygonal cells becoming distinct a short distance from the summit of the egg extend to slightly beyond the equator. Here the raised reticulation forming the cells becomes ribs connected by transverse ridges. These fade out on the base of the egg. The depressed surface is minutely punctuated. Around the micropyle the cells give way to small wrinkles directed toward the micropyle. Color very light cream.

First Instar. Head width, .50 mm.; head height, .55 mm. Body length, 2.5 to 3 mm. Head brown, finely corrugate. Few transparent hairs. Body very light yellow, more or less evenly speckled with small reddish freckles, more numerous anteriorly and posteriorly. Background of whitish mottling especially on anterior segments. Hairs on body transparent to black. Two pairs of forwardly recurved hairs of equal length on anal segment. A more posterior pair shorter and decurved back. First pair of legs and tips of second pair fuscous.

Second Instar. Head width, .6 mm; head height, .75 mm. Body length, 3.5 to 4.5 mm. Head almost black, faintly shagreened. First and second pairs of legs and the tips of the third pair fuscous. Body brownish, more or less uniformly covered with short black spines arising from black tubercles. Anterior portion of the body with pronounced white and chocolate mottling. White mottling more pronounced than in previous instar. Freckles larger, darker, and closer together. Spiracles light chocolate with black circumference. Anal plate with numerous medium sized hairs.

Third Instar. Head width, .85 mm; head height, 1 mm. Body length, 5 to 7 mm. Head black to dark chocolate. Body same as previous instar with the following additions. Concentration of very small freckles around spiracles. Lighter substigmatal line on thoracic segments due to absence of mottling. Spots arranged in more or less dorsal transverse rows. Very few ventrally. Pleural region naked except for a longitudinal band of spots. Spots more profuse around legs.

Fourth Instar. Head width, 1.2 mm.; head height, 1.4 mm. Body length, 8 mm.

Head dull chocolate to black. Body chocolate, mottled with darker chocolate and white. Darker anteriorly and with a dark chocolate mid-dorsal line. Dull light chocolate substigmatal band more pronounced on the thoracic segments.

Eggs laid August 1 to 3. Emerged August 17, having passed from thirteen to sixteen days in this stage. The first instar is concluded in from nine to twelve days, moults having occurred on August 26 and 29. The second and third instars require from twelve to fifteen days each. One animal reached the fourth instar on the last day of September.

Poanes hobomok Harr.

Egg. White to cream. Area above equator divided into many five to six sided cells measuring approximately .01 mm. and sculptured with from eighteen to twenty-one microscopic punctuations. The base of the egg viewed from the bottom is circular; viewed from the side it is not flat but slightly convex. Sides slightly bulging. Top barely flattened, not to such a degree as in *P. manataaqua.* Height, .73 mm.; greatest diameter, .95 mm.

First Instar. Head width, .50 mm.; head height, .55 mm. Body length after feeding, 4.5 mm. Head smooth and shining with many short pale brown to colorless hairs. Hair sockets giving the head a slight pockmarked appearance. Head brown. Ocelli light with dark rims. Mandibles dark brown; other appendages light brown. Shield .4 mm. wide, slightly darker than head. Body cream color sparsely clothed with short transparent hairs. Two pairs of long anteriorly recurved hairs on the last segment. Legs and prolegs dead white. Spiracles light brown with a darker rim.

Second Instar. Head width, .8 mm.; head height, .9 mm. Body length, 5 mm. Head lighter in color than previous instar, with dark brown on the edge of the foramen magnum. Fine reticulation of darker brown over whole head capsule. Shield very narrow, length, 4.5 mm. Body white to slightly greenish dorsally. Last segment pale rusty. Legs and prolegs white. Body covered with many short black hairs arising from black tubercles, those on the last segments longer than the rest. The hairs are less numerous on segments four to seven. A row of short hairs occurs on the shield.

Third Instar. Head width, 1.1 mm.; head height, 1.3 mm. Body length, 8 mm. Head nearly black, minutely shagreened, with many short white hairs. Shield .8 mm. long, same color as head. Body dark green to brown. Covered with black tubercles bearing very short black spines. Tips of legs brownish. Tubercles arranged in more or less transverse lines dorsally and ventrally. The dorsal lines extending to the stigmatal line. The substigmatal line is naked, therefore, appearing lighter in color than the rest of the body. Below this is a band of tubercles, ventral to this another naked area, and finally ventral to this naked area a band of tubercles situated just at the bases of the legs. The ventral transverse rows of dots extend almost but not quite to this last band. Ventral surface pale green. Spiracles fuscous with darker circumference.

Eggs laid on June 14 emerged June 22. The first instar requires from about eight to ten days; the second, from eight to seventeen. Moulting to the third instar occurred on July 9, 11, 18, 22, and 23. One animal moulted into the fourth instar July 31 having required about twenty days.

The life history of animals emerging from the eggs of the dark female of this species, *P. hobomok* form *pocahontas* Scud., was identical with that described above. Saunders' description of the egg and first instar of *Hesperia hobomok* Harr. without a doubt refers to this species since *Poanes zabulon* Bdv. & Lec. does not occur in Ontario.

All of the larvae described above fed on various grasses. In all cases shortly before emergence from the egg the head of the larva was visible through the shell. The individual larvae exhibited considerable diversity in the amount of the egg shell that they ate after emerging.

LITERATURE CITED

Saunders, W., 1869. Entomological Notes. Paper No. IV. Can. Ent., 1(8): 66.
Scudder, S. H., 1889. Butterflies of eastern United States and Canada. 2: 1617-1732.

THELYTOKOUS PARTHENOGENESIS IN CEPHUS CINCTUS NORT.: A CRITICISM.

BY STANLEY G. SMITH,
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I have read with great interest C. W. Farstad's paper (1938) on "Thelyotokous parthenogenesis in *Cephus cinctus* Nort.," since it parallels so closely my own problem in *Diprion polytomum* Hartig. But, whilst agreeing with his final conclusion that there are doubtless two forms of *C. cinctus* manifesting alternative modes of parthenogenetic reproduction in different regions of the Province of Alberta, I must nevertheless draw attention to certain statements made by this worker which appear, in the light of modern cyto-genetic knowledge, to be highly improbable.

It is one of the characteristics of the Hymenoptera that throughout the order females are endowed with the ability to reproduce by parthenogenetic means. This term was originally defined by Owen (see Darlington, 1937) as "a form of apomixis* in which the female gamete develops without fertilization." Further, there are two distinct categories, namely arrhenotokous, haploid, or facultative parthenogenesis, in which fertilization has failed first, and thelytokous, diploid, or obligatory parthenogenesis. in which numerical chromosome reduction, or meiosis, fails first.

In *Diprion polytomum* we find these two forms of parthenogenesis occurring separately in what, for the present, we may regard as sub-species. In both sub-species I have found (1938) the females to possess the diploid number of chromosomes while the males in both are haploid. The double set of chromosomes is retained in the thelytokous egg by means of a special regulatory mechanism which either inhibits or compensates for numerical reduction. When this mechanism breaks down, as it does on rare occasions (once in 1,200 times for *D. polytomum* in Gaspe and New Brunswick), males of the expected haploid constitution arise. In so far as these findings are in complete agreement with those of other cytologists working in this feld we may justifiably accept them as typical of the alternative parthenogenetic types. There is in fact no case known in the Metazoa in which the complementary chromosome relationships

*Apomixis—the occurrence of the external form of sexual reproduction with the omission of fertilization and usually meiosis as well (Winkler, see Darlington, 1937).

obtain. Further, I would like to stress that males, whether from arrhenotokous or thelytokous mothers, are completely indistinguishable in chromosome behaviour, so that, unless there are morphological or numerical differences, as there are in the sub-species of *D. polytomum*, we have no cytological criterion for their identificaton.

In view of his statement that "males can probably be produced only from fertilized eggs" it would appear that Farstad is of the opinion that *C. cinctus* is exceptional in that the female is haploid and the male diploid, although he does not make use of these specific terms. This misconception doubtless arises from the fact that it is only in the arrhenotokous form that fertilization can occur. But by analogy with *D. polytomum* it follows that all eggs of facultative females must, before fertilization, be haploid and potentially males, as simple rearing to maturity would prove. In the case of obligatory forms the eggs, being already diploid, would, following fertilization, become triploid and thus undoubtedly sterile. Males would, therefore, not only be useless but actually detrimental so far as the survival of the species is concerned.

With regard to a possible mode of origin of the thelytokous form it is clearly speculative and barely plausible to conceive of an unfavourable complex of nutritional factors capable of eliminating solely the male sex. It appears to me more in accord with modern biological thought to interpret the dichotomy as resulting from a simple gene mutation initiating the obligatory mode of parthenogenesis since this, on its own, would constitute a most effective barrier to crossing with the parental arrhenotokous form.

REFERENCES

Darlington, C. D. 1937. Recent Advances in Cytology 2nd Ed. J. and A. Churchill, London.

Farstad, C. W. 1938. Thelyotokous parthenogenesis in *Cephus cinctus* Nort. Can. Ent. LXX (10): 206-207.

Smith, S. G. 1938. Cytology of Spruce Sawfly and its Control in Eastern Canada. Nature 141: 121.

ADDITIONS AND CORRECTIONS TO CHECK LIST OF MACROLEPIDOPTERA OF ALBERTA.

BY KENNETH BOWMAN,
Edmonton, Alta.

Additions

1505	*Anomogyna speciosa apropitia* Benj.	7 B.N.L.C. Nx.
2179	*Eurotype contadina albertae* McD.	9 Lb.B.
2363	*Eremobia maillardi* Gey	7-8 Cd.N.
2480	*Acronycta lepusculina* Gn.	7 C.
N.S.	*Calamia basistriga* McD.	9 E.C.N.Lb.
3693	*Euthyatira pudens pennsylvanica* Sm.	5 E.
4054	*Orthonama obstipata* Fabr.	8-9 N.
4088	*Eulype hastata gothicata* Gn.	6 N.
N.S.	" *albodecorata confusa* McD.	6 N.W.B.Bm.
N.S.	" " *stygiata* McD.	6 N.
4161	*Eupithecia edna* Hlst.	6 B.N.
4171	" *casloata* Dyar.	6 N.E.
4323	*Drepanulatrix litaria* Hlst.	8 Bm.

4674 *Plagodis alcoolaria* Gn. .... 6 E.
8488 *Hepialus roseicaput* N. & D. .... 8 P.Cd.B.

Delete

562 *Pamphila comma* L. Only the races *manitoba* and *assiniboia* occur in Alberta.
1246 *Euxoa niveilinea* Grt. Included in error.
2362 *Eremobia alticola* Sm. Should be *maillardi* Gey.
2501 *Acronycta sperata* Grt. Included in error.
2800 *Calamia variana* Morr. Should be *basistriga* McD.
4672 *Plagodis fervidaria* H. S. Should be *alcoolaria* Sm.

BOOK NOTICES.

A Catalogue of the Original Descriptions of the Rhopalocera Found North of the Mexican Border, edited by F. Martin Brown. Vol. I, part 1, The Hesperioidea, by E. L. Bell. Price, 50 cents. Published as Bulletin of the Cheyenne Mt. Museum, Colorado Springs, Colo.

A publication of this nature will doubtless possess when completed considerable value in that it brings together in a concise form the references to the original descriptions of all North American species, with their synonyms, in any given family of butterflies. Unfortunately for the advanced taxonomist its value will be limited to this one item, and he will still be forced to search through the literature for later references, figures, synonymical notes, etc., when working up any species or group of butterflies. It seems a great pity that the catalogue has not been planned along more extensive lines, to include, at least, all the more important references under each specific head; had this been done, the editor and his collaborators would not only have earned the undying gratitude of working lepidopterists but also have made a really valuable contribution to our literature on this subject.

Part I of this catalogue, as noted above, is by E. L. Bell and deals with the Hesperioidea; it is largely a recapitulation, in a somewhat restricted form, of the well-known work on this superfamily by Lindsey, Bell and Williams (1931). Whenever available the type localities for each species and its synonyms have been included, a very useful piece of information; no attempt, however, has been made to deal with the range of distribution of the individual species. Other more serious omissions, to our mind, are the lack of all generic synonymy and the absence of information as to when and how the fixation of the genotypes occurred; a mere listing of these genotypes, as has been done in the present volume, has, of course, its uses, in that it informs us of the author's conception of the genus but it leaves us no opportunity of checking up on the accuracy of his designations. An inclusion of generic synonymy would help to solve several doubtful points as for instance why the genus *Wallengrenia* Berg has been substituted for the well-known *Catia* G. & S.

On the whole the get-up of the catalogue is eminently satisfactory, but we would suggest that a more careful reading of the proof would have eliminated a number of typographical errors that have crept in. J. McD.

The Fulgoridae of Ohio, by Herbert Osborn, Bulletin 35, Ohio Biological Survey, 1938. Published by the University of Ohio, Columbus, Ohio, price 75 cents.

This work, comprising 66 pages and 42 text figures, is the latest of the publications of the Ohio Biological Survey dealing with the Homoptera of this state; already bulletins on leafhoppers and jumping plant-lice have been issued and we are promised articles on Cicadidae, Membracidae and Cercopidae in the near future. Dealing, as it does, with well over 100 species of Fulgorids the bulletin should prove a most valuable asset to students as a means of introduction to this interesting family and an excellent help in the identification of material.

J. McD.

Mailed Saturday, Deecember 31st, 1938.

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